CLAIMS

What is claimed is:

1. A method for navigating a UAV, the method comprising:

receiving in a remote control device a user's selection of a GUI map pixel that represents a waypoint for UAV navigation, the pixel having a location on the GUI;

mapping the pixel's location on the GUI to Earth coordinates of the waypoint;

transmitting the coordinates of the waypoint to the UAV;

reading a starting position from a GPS receiver on the UAV;

piloting the UAV, under control of a navigation computer on the UAV, from the starting position to the waypoint in accordance with a navigation algorithm; and

while piloting the UAV from the starting position to the waypoint:

reading from the GPS receiver a sequence of GPS data representing a flight path of the UAV; and

depicting the flight of the UAV with 3D computer graphics, including a computer graphic display of a satellite image of the Earth, in dependence upon

the GPS data.

2. The method of claim 1 wherein depicting the flight of the UAV further comprises:

determining, on the UAV, a display attitude of the UAV in dependence upon the sequence of GPS data;

calculating, on the UAV, from the sequence of GPS data, the UAV's course;

creating, on the UAV, images for display in dependence upon the display attitude, the course, and a satellite image stored on the UAV; and

downloading the images for display from the UAV to the remote control device.

3. The method of claim 1 wherein depicting the flight of the UAV further comprises:

downloading the GPS sequence from the UAV to the remote control device;

determining, in the remote control device, a display attitude of the UAV in dependence upon the sequence of GPS data;

calculating, in the remote control device, from the sequence of GPS data, the UAV's course; and

creating, in the remote control device, images for display in dependence upon the display attitude, the course, and a satellite image stored on the remote control device.

15

4. The method of claim 1 wherein depicting the flight of the UAV further comprises determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

5 detecting changes in the UAV's course from the sequence of GPS data;

determining a display roll angle in dependence upon the detected course changes.

5. The method of claim 1 wherein depicting the flight of the UAV further comprises determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

5 detecting changes in the UAV's course from the sequence of GPS data;

determining a display yaw angle in dependence upon the detected course changes.

6. The method of claim 1 wherein depicting the flight of the UAV further comprises determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

5 detecting changes in the UAV's altitude from the sequence of GPS data;

determining a display pitch angle in dependence upon the detected altitude changes.

7. The method of claim 1 further comprising:

receiving user selections of a multiplicity of GUI map pixels representing waypoints, each pixel having a location on the GUI

mapping each pixel location to Earth coordinates of a waypoint;

assigning one or more UAV instructions to each waypoint;

transmitting the coordinates of the waypoints and the UAV instructions to the UAV;

storing the coordinates of the waypoints and the UAV instructions in computer memory on the UAV;

piloting the UAV to each waypoint in accordance with one or more navigation algorithms; and

operating the UAV at each waypoint in accordance with the UAV instructions for each waypoint.

8. The method of claim 1 wherein mapping the pixel's location on the GUI to Earth coordinates of the waypoint further comprises:

mapping pixel boundaries of the GUI map to Earth coordinates;

identifying a range of latitude and a range of longitude represented by each pixel; and

locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map.

9. The method of claim 8 wherein locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map further comprises:

multiplying the range of longitude represented by each pixel by a column number of the selected pixel, yielding a first multiplicand;

multiplying the range of longitude represented by each pixel by 0.5, yielding a second multiplicand;

adding the first and second multiplicands to an origin longitude of the GUI map;

multiplying the range of latitude represented by each pixel by a row number of the selected pixel, yielding a third multiplicand;

multiplying the range of latitude represented by each pixel by 0.5, yielding a fourth multiplicand; and

adding the third and fourth multiplicands to an origin latitude of the GUI map.

10. A system for navigating a UAV, the system comprising:

means for receiving in a remote control device a user's selection of a GUI map pixel that represents a waypoint for UAV navigation, the pixel having a location on the GUI;

means for mapping the pixel's location on the GUI to Earth coordinates of the waypoint;

means for transmitting the coordinates of the waypoint to the UAV;

means for reading a starting position from a GPS receiver on the UAV;

means for piloting the UAV, under control of a navigation computer on the UAV, from the starting position to the waypoint in accordance with a navigation algorithm; and

while piloting the UAV from the starting position to the waypoint:

means for reading from the GPS receiver a sequence of GPS data representing a flight path of the UAV; and

means for depicting the flight of the UAV with 3D computer graphics, including a computer graphic display of a satellite image of the Earth, in dependence upon the GPS data.

11. The system of claim 10 wherein means for depicting the flight of the UAV

further comprises:

means for determining, on the UAV, a display attitude of the UAV in dependence upon the sequence of GPS data;

means for calculating, on the UAV, from the sequence of GPS data, the UAV's course;

means for creating, on the UAV, images for display in dependence upon the display attitude, the course, and a satellite image stored on the UAV; and

means for downloading the images for display from the UAV to the remote control device.

12. The system of claim 10 wherein means for depicting the flight of the UAV further comprises:

means for downloading the GPS sequence from the UAV to the remote control device;

means for determining, in the remote control device, a display attitude of the UAV in dependence upon the sequence of GPS data;

means for calculating, in the remote control device, from the sequence of GPS data, the UAV's course; and

means for creating, in the remote control device, images for display in

dependence upon the display attitude, the course, and a satellite image stored on the remote control device.

13. The system of claim 10 wherein means for depicting the flight of the UAV further comprises means for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means for detecting changes in the UAV's course from the sequence of GPS data;

means for determining a display roll angle in dependence upon the detected course changes.

14. The system of claim 10 wherein means for depicting the flight of the UAV further comprises means for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means for detecting changes in the UAV's course from the sequence of GPS data;

means for determining a display yaw angle in dependence upon the detected course changes.

15. The system of claim 10 wherein means for depicting the flight of the UAV further comprises means for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means for detecting changes in the UAV's altitude from the sequence of GPS data;

means for determining a display pitch angle in dependence upon the detected altitude changes.

16. The system of claim 10 further comprising:

means for receiving user selections of a multiplicity of GUI map pixels representing waypoints, each pixel having a location on the GUI

means for mapping each pixel location to Earth coordinates of a waypoint;

means for assigning one or more UAV instructions to each waypoint;

means for transmitting the coordinates of the waypoints and the UAV instructions to the UAV;

means for storing the coordinates of the waypoints and the UAV instructions in computer memory on the UAV;

means for piloting the UAV to each waypoint in accordance with one or more navigation algorithms; and

means for operating the UAV at each waypoint in accordance with the UAV instructions for each waypoint.

17. The system of claim 10 wherein means for mapping the pixel's location on the GUI to Earth coordinates of the waypoint further comprises:

means for mapping pixel boundaries of the GUI map to Earth coordinates;

means for identifying a range of latitude and a range of longitude represented by each pixel; and

means for locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map.

18. The system of claim 17 wherein means for locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map further comprises:

means for multiplying the range of longitude represented by each pixel by a column number of the selected pixel, yielding a first multiplicand;

means for multiplying the range of longitude represented by each pixel by 0.5, yielding a second multiplicand;

means for adding the first and second multiplicands to an origin longitude of the GUI map;

means for multiplying the range of latitude represented by each pixel by a row number of the selected pixel, yielding a third multiplicand;

means for multiplying the range of latitude represented by each pixel by 0.5, yielding a fourth multiplicand; and

means for adding the third and fourth multiplicands to an origin latitude of the GUI map.

19. A computer program product for navigating a UAV, the computer program product comprising:

a recording medium;

means, recorded on the recording medium, for receiving in a remote control device a user's selection of a GUI map pixel that represents a waypoint for UAV navigation, the pixel having a location on the GUI;

means, recorded on the recording medium, for mapping the pixel's location on the GUI to Earth coordinates of the waypoint;

means, recorded on the recording medium, for transmitting the coordinates of the waypoint to the UAV;

means, recorded on the recording medium, for reading a starting position from a GPS receiver on the UAV;

means, recorded on the recording medium, for piloting the UAV, under control of a navigation computer on the UAV, from the starting position to the waypoint in accordance with a navigation algorithm; and

while piloting the UAV from the starting position to the waypoint:

means, recorded on the recording medium, for reading from the GPS receiver a sequence of GPS data representing a flight path of the UAV; and

means, recorded on the recording medium, for depicting the flight of the UAV with 3D computer graphics, including a computer graphic display of a satellite image of the Earth, in dependence upon the GPS data.

20. The computer program product of claim 19 wherein means, recorded on the recording medium, for depicting the flight of the UAV further comprises:

means, recorded on the recording medium, for determining, on the UAV, a display attitude of the UAV in dependence upon the sequence of GPS data;

means, recorded on the recording medium, for calculating, on the UAV, from the sequence of GPS data, the UAV's course;

means, recorded on the recording medium, for creating, on the UAV, images for display in dependence upon the display attitude, the course, and a satellite image stored on the UAV; and

means, recorded on the recording medium, for downloading the images for display from the UAV to the remote control device.

21. The computer program product of claim 19 wherein means, recorded on the recording medium, for depicting the flight of the UAV further comprises:

means, recorded on the recording medium, for downloading the GPS sequence from the UAV to the remote control device;

means, recorded on the recording medium, for determining, in the remote

control device, a display attitude of the UAV in dependence upon the sequence of GPS data;

means, recorded on the recording medium, for calculating, in the remote control device, from the sequence of GPS data, the UAV's course; and

means, recorded on the recording medium, for creating, in the remote control device, images for display in dependence upon the display attitude, the course, and a satellite image stored on the remote control device.

22. The computer program product of claim 19 wherein means, recorded on the recording medium, for depicting the flight of the UAV further comprises means, recorded on the recording medium, for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means, recorded on the recording medium, for detecting changes in the UAV's course from the sequence of GPS data;

means, recorded on the recording medium, for determining a display roll angle in dependence upon the detected course changes.

23. The computer program product of claim 19 wherein means, recorded on the recording medium, for depicting the flight of the UAV further comprises means, recorded on the recording medium, for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means, recorded on the recording medium, for detecting changes in the

UAV's course from the sequence of GPS data;

means, recorded on the recording medium, for determining a display yaw angle in dependence upon the detected course changes.

24. The computer program product of claim 19 wherein means, recorded on the recording medium, for depicting the flight of the UAV further comprises means, recorded on the recording medium, for determining a display attitude of the UAV in dependence upon the sequence of GPS data, including:

means, recorded on the recording medium, for detecting changes in the UAV's altitude from the sequence of GPS data;

means, recorded on the recording medium, for determining a display pitch angle in dependence upon the detected altitude changes.

25. The computer program product of claim 19 further comprising:

means, recorded on the recording medium, for receiving user selections of a multiplicity of GUI map pixels representing waypoints, each pixel having a location on the GUI

means, recorded on the recording medium, for mapping each pixel location to Earth coordinates of a waypoint;

means, recorded on the recording medium, for assigning one or more UAV instructions to each waypoint;

means, recorded on the recording medium, for transmitting the coordinates of the waypoints and the UAV instructions to the UAV;

means, recorded on the recording medium, for storing the coordinates of the waypoints and the UAV instructions in computer memory on the UAV;

means, recorded on the recording medium, for piloting the UAV to each waypoint in accordance with one or more navigation algorithms; and

means, recorded on the recording medium, for operating the UAV at each waypoint in accordance with the UAV instructions for each waypoint.

26. The computer program product of claim 19 wherein means, recorded on the recording medium, for mapping the pixel's location on the GUI to Earth coordinates of the waypoint further comprises:

means, recorded on the recording medium, for mapping pixel boundaries of the GUI map to Earth coordinates;

means, recorded on the recording medium, for identifying a range of latitude and a range of longitude represented by each pixel; and

means, recorded on the recording medium, for locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map.

27. The computer program product of claim 26 wherein means, recorded on the recording medium, for locating a region on the surface of the Earth in dependence upon the boundaries, the ranges, and the location of the pixel on the GUI map further comprises:

means, recorded on the recording medium, for multiplying the range of longitude represented by each pixel by a column number of the selected pixel, yielding a first multiplicand;

means, recorded on the recording medium, for multiplying the range of longitude represented by each pixel by 0.5, yielding a second multiplicand;

means, recorded on the recording medium, for adding the first and second multiplicands to an origin longitude of the GUI map;

means, recorded on the recording medium, for multiplying the range of latitude represented by each pixel by a row number of the selected pixel, yielding a third multiplicand;

means, recorded on the recording medium, for multiplying the range of latitude represented by each pixel by 0.5, yielding a fourth multiplicand; and

means, recorded on the recording medium, for adding the third and fourth multiplicands to an origin latitude of the GUI map.